WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2	**Calorimeter Upgrades**	**$962,708.00**	**$852,728.00**	**$109,356.00**	**0**	**0**	**0**

Notes
WBS Definition-
Summary task for the entire calorimeter project.

1.2.1	**Central Preshower and Crack Detectors**	**$759,973.00**	**$676,201.00**	**$83,772.00**	**0**	**0**	**0**

Notes
WBS Definition-
Summary task for the central preshower/crack detector subproject.

1.2.1.1	Start of Preshower/Crack Subproject	$0.00	$0.00	$0.00	0	0	4

Notes
WBS Definition:
Start of central preshower/crack detector subproject. (Milestone)

1.2.1.2	**Research and Development(US)**	**$55,672.00**	**$55,672.00**	**$0.00**	**0**	**0**	**0**

Notes
WBS Definition-
Summary task for the U.S. R+D for the preshower/crack subproject.

1.2.1.2.1	Procure mechanical parts and fixtures for prototype modules	$13,000.00	$13,000.00	$0.00	0	0	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
8	*MANDSPASS*	*13,000*	*13,000*	*0 mons*	*Mon 4/1/02*	*Thu 1/16/03*	*$13,000.00*	*$0.00*	*$0.00*	*$13,000.00*

Notes
WBS Definition-
Procure mechanical parts and fixtures for prototype modules.

Labor BOE-
N/A

M&S BOE- (written estimate)
Estimate from ANL engineer based on costs of initial prototype.

1.2.1.2.2	Assembly and testing of prototype modules	$21,672.00	$21,672.00	$0.00	0	0	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
8	*MANDSPASS*	*21,672*	*21,672*	*0 mons*	*Tue 5/28/02*	*Fri 4/11/03*	*$21,672.00*	*$0.00*	*$0.00*	*$21,672.00*

Notes
WBS Definition-
Assembly and testing of prototype modules.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Assembly and testing of prototype modules" continued

Notes

Labor BOE-
N/A

M&S BOE-(written estimate)
Estimate from ANL engineer based on assembly of initial prototype.

1.2.1.2.3	Assembly of electronics transition card and cables	$5,000.00	$5,000.00	$0.00	0	0	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
8	*MANDSPASS*	*5,000*	*5,000*	*0 mons*	*Thu 10/17/02*	*Fri 4/11/03*	*$5,000.00*	*$0.00*	*$0.00*	*$5,000.00*

Notes

WBS Definition-
Assembly of prototype electronics transition cards and cables.

Labor BOE-
N/A

M&S BOE-(written estimate)
Estimate from ANL engineer based on similar card from Minos.

1.2.1.2.4	Prototype fiber bundles and phototube box	$16,000.00	$16,000.00	$0.00	0	0	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
8	*MANDSPASS*	*16,000*	*16,000*	*0 mons*	*Wed 7/24/02*	*Fri 4/11/03*	*$16,000.00*	*$0.00*	*$0.00*	*$16,000.00*

Notes

WBS Definition-
Prototype fiber bundles and phototube box.

Labor BOE-
N/A

M&S BOE-(written estimate)
Estimate from MSU engineer based on CDF and Atlas experience.

1.2.1.2.5	Schedule Contingency for Prototype R+D	$0.00	$0.00	$0.00	0	0	0
1.2.1.3	**Research and Development(Japan)**	**$28,940.00**	**$28,940.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
Summary task for the R+D in Japan for the preshower/crack subproject.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.3.1	Procure phototubes for testing	$28,940.00	$28,940.00	$0.00	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	INKIND	28,940	28,940	0 mons	Mon 4/29/02	Fri 12/13/02	$28,940.00	$0.00	$0.00	$28,940.00

Notes

WBS Definition-
Procure phototubes for testing for R+D.

Labor BOE-
N/A

M&S BOE-(written estimate)
Initial purchase of 20 Hamamatsu phototubes by Univ. of Tsukuba for testing is complete.
In addition, different phototube bases will be tested.

1.2.1.3.2	Test phototubes	$0.00	$0.00	$0.00	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
4	PhysicistU	10%	96 hrs	0 mons	Wed 8/21/02	Fri 2/14/03	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
Test phototubes for R+D.

Labor BOE-
N/A

M&S BOE-
Physicist labor over 5 months to test the phototubes.

1.2.1.3.3	Schedule Contingency for Phototube R+D	$0.00	$0.00	$0.00	0	0	0
1.2.1.4	**Research and Development(Italy)**	**$18,000.00**	**$18,000.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
Summary task for the R+D in Italy for the preshower/crack subproject.

1.2.1.4.1	Procure scintillator and fibers for prototypes	$18,000.00	$18,000.00	$0.00	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	INKIND	18,000	18,000	0 mons	Mon 4/29/02	Thu 1/16/03	$18,000.00	$0.00	$0.00	$18,000.00

Notes

WBS Definition-
Procure scintillator and fibers for prototype modules.

Labor BOE-
N/A

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Procure scintillator and fibers for prototypes" continued							

Notes

M&S BOE-(written estimates)
Scintillator and fiber estimates based on initial purchases
from Dubna (scintillator) and PoliHiTech (fibers).

1.2.1.4.2	Test scintillator and fibers	$0.00	$0.00	$0.00	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
4	PhysicistU	10%	147.2 hrs	0 mons	Tue 5/28/02	Thu 2/20/03	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
Test scintillator and fibers.

Labor BOE-
N/A

M&S BOE-
Physicist labor to perform tests of scintillator and fibers.

1.2.1.4.3	Schedule Contingency for Optics R+D	$0.00	$0.00	$0.00	0	0	0
1.2.1.5	**Procure parts**	**$498,993.00**	**$498,993.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
Summary task for parts procurement common to both preshower and crack detectors.

1.2.1.5.1	**Phototubes and bases**	**$264,600.00**	**$264,600.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
Procurement of 220 multichannel phototubes and bases from Hamamatsu.

Labor BOE-
N/A

M&S BOE-
Hamamatsu quote to Fumi Ukegawa (Univ of Tsukuba) on 2-28-2002, reinforced by an initial purchase for R+D of 20 tubes. Price is for 220 tubes and bases (includes 15% spares) of H8711A-10mod 16-channel type. Exchange rate assumed was 120 yen/dollar.
Price depends on discount rate, before discounts or tax the tube price is 180,000 yen for
the standard base, *1.7% for an outside vendor to add the SHV cable = 183,060 yen.
Assumed purchase sequence is:
JY2002 40 tubes - 15% discount = 6.22 Myen
JY2003 130 tubes - 30% discount = 16.66 Myen
JY2004 50 tubes - 20% discount = 7.32 Myen
Total = 30.20 Myen

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Phototubes and bases" continued

Notes

Total + 5% tax = 31.71 Myen = $264,250

True price is 149,041 yen per tube, including all discounts which change year by year. This gives an estimate of $273,243.

1.2.1.5.1.1	JY 2002 Batch	$54,600.00	$54,600.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	INKIND	54,600	54,600	0 mons	Mon 5/12/03	Tue 8/5/03	$54,600.00	$0.00	$0.00	$54,600.00

Notes

WBS Definition-
Procurement of multichannel phototubes during Japanese fiscal year 2002.

Labor BOE-
N/A

M&S BOE-
This is covered in the summary task.

1.2.1.5.1.2	JY 2003 Batch	$146,000.00	$146,000.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish
10	INKIND	146,000	146,000	0 mons	Thu 9/4/03	Wed 11/26/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	INKIND	146,000	$146,000.00	$0.00	$0.00	$146,000.00

Notes

WBS Definition-
Procurement of multichannel phototubes during Japanese fiscal year 2003.

Labor BOE-
N/A

M&S BOE-
This is covered in the summary task.

1.2.1.5.1.3	JY 2004 Batch	$64,000.00	$64,000.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish
10	INKIND	64,000	64,000	0 mons	Wed 7/21/04	Wed 10/13/04

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	INKIND	64,000	$64,000.00	$0.00	$0.00	$64,000.00

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"JY 2004 Batch" continued

Notes

WBS Definition-
Procurement of multichannel phototubes during Japanese fiscal year 2004.

Labor BOE-
N/A

M&S BOE-
This is covered in the summary task.

1.2.1.5.1.4	Schedule Contingency for Phototube Procurement	$0.00	$0.00	$0.00	0	0	0
1.2.1.5.2	Electronics Transition Card	$24,312.00	$24,312.00	$0.00	0.3	0	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
8	*MANDSPASS*	*24,312*	*24,312*	*0 mons*	*Tue 6/10/03*	*Wed 11/26/03*	*$24,312.00*	*$0.00*	*$0.00*	*$24,312.00*

Notes

WBS Definition-
Transistion card and cables that go from phototubes to the back of the Shower Maximum
Detector VME crate.

Labor BOE-
N/A

M&S BOE-
Detailed estimate from Gary Drake (ANL) based on Minos design.
Transition card itself is $75/card * 2/wedge * 48 wedges * 10% spare = $7920,
including all parts and assembly labor.
Engineering for the card is $8K, a one-time cost.
Total cost of transition card is $15,920.

Cables to transition card: $35/card * 4/wedge * 48 wedges * 10% spare = $7,392 including all parts and assembly labor.
Engineering for this cable is $1K, a one-time cost.
Total cost of cables is $8,392.

Total cost is $24,312.

1.2.1.5.3	HV Supplies and cables	$50,000.00	$50,000.00	$0.00	0.3	0	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
10	*INKIND*	*50,000*	*50,000*	*0 mons*	*Mon 4/14/03*	*Wed 10/1/03*	*$50,000.00*	*$0.00*	*$0.00*	*$50,000.00*

Notes

WBS Definition-
High Voltage system plus cables and connectors.

Labor BOE-
N/A

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"HV Supplies and cables" continued

Notes

M&S BOE-
CAEN SY527 with 10 A932AN cards. Direct quote to Stefano Lami from CAEN representative on 9-01-2001. add another $10K for cables per Stefano's estimate.

1.2.1.5.4	Clear Fiber Bundle parts	$12,100.00	$12,100.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	12,100	12,100	0 mons	Wed 7/9/03	Wed 1/7/04	$12,100.00	$0.00	$0.00	$12,100.00

Notes

WBS Definition-
Clear fiber bundles that go from the counters to the phototube box.

Labor BOE-
N/A

M&S BOE-
Detailed estimate from MSU engineer Ron Richards. $12100

1.2.1.5.5	Wavelength-shifting fiber holder parts	$7,800.00	$7,800.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	7,800	7,800	0 mons	Wed 7/9/03	Wed 10/1/03	$7,800.00	$0.00	$0.00	$7,800.00

Notes

WBS Definition-
Plastic holders for the wavelength shifting fibers that go on the counters.

Labor BOE-
N/A

M&S BOE-
Detailed estimate from MSU engineer Ron Richards. $7800

1.2.1.5.6	Phototube box parts	$36,000.00	$36,000.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	36,000	36,000	0 mons	Wed 7/9/03	Tue 12/30/03	$36,000.00	$0.00	$0.00	$36,000.00

Notes

WBS Definition-
Clear fiber bundles that go from the counters to the phototube box.

Labor BOE-
N/A

M&S BOE-
Detailed estimate from MSU engineer Ron Richards. $36000

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.5.7	**Preshower Detector parts**	**$85,262.00**	**$85,262.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
Summary task for procurement of parts for preshower.

1.2.1.5.7.1	Scintillator	$36,288.00	$36,288.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	*INKIND*	*36,288*	*36,288*	*0 mons*	*Fri 5/16/03*	*Mon 8/11/03*	*$36,288.00*	*$0.00*	*$0.00*	*$36,288.00*

Notes

WBS Definition:
Amount INFN has agreed to pay JINR (Dubna) for their 2 cm scintillator, and provide in-kind to this project.

Labor BOE:
n/a

M&S BOE:
Costs are based on quote from INFN's Giorgio Belletini of $28/liter.
How many liters are needed?
1 sheet is 180 cm x 45 cm x 2cm = 16.2 liter = $453.6
Assume 15 cm x 15 cm tiles including cutting space, this is
36 tiles per sheet. Need 54 tiles/wedge * 48 wedges = 2592 tiles.
Add 10% spares, this gives 80 sheets * $453.6 = $36288

1.2.1.5.7.2	Optical Fibers	$36,510.00	$36,510.00	$0.00	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	*INKIND*	*36,510*	*36,510*	*0 mons*	*Fri 5/16/03*	*Mon 8/11/03*	*$36,510.00*	*$0.00*	*$0.00*	*$36,510.00*

Notes

WBS Definition:
Wavelength shifting and clear fibers purchased by INFN and provided in-kind to this project.

Labor BOE:
n/a

M&S BOE:
Total length of WLS fibers =
54 channels * 1 fiber/channel * 1.5m average length* 48 wedges *20% spare = 4500 m
Total length of clear fiber =
54 channels * 1 fiber/channel * 5m average length * 48 wedges *20% spare = 15000 m
For this quantity of fibers the quote from Kai Changi of Kuraray America is
$2.28/m for WLS and $1.75/m for clear.
Total cost is then:
$2.28 * 4500 = $10260 WLS
$1.75 * 15000 = $26250 clear

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Optical Fibers" continued

Notes

$10260 + $26250 = $36510 total

1.2.1.5.7.3	Sheet metal and misc. supplies	$12,464.00	$12,464.00	$0.00	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	12,464	12,464	0 mons	Mon 4/14/03	Wed 10/1/03	$12,464.00	$0.00	$0.00	$12,464.00

Notes

WBS Definition:
Sheet metal and other supplies to make the counter shell.

Labor BOE:
n/a

M&S BOE:
Sheet metal estimate from Jim Grudzinski (Argonne) comes from purchase and shop time for
full-size prototype: $188 per module * 53 = $9964 for sheet metal, $2500 for epoxies and other misc. Total: $12464

1.2.1.5.8	**Crack Detector parts**	**$18,919.00**	**$18,919.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
Summary task for procurement of parts for crack detector.

1.2.1.5.8.1	Scintillator	$10,000.00	$10,000.00	$0.00	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	INKIND	10,000	10,000	0 mons	Fri 5/16/03	Thu 4/29/04	$10,000.00	$0.00	$0.00	$10,000.00

Notes

WBS Definition:
Scintillator for CCR purchased from Bicron by INFN.

Labor BOE:
n/a

M&S BOE:
Physicist estimate based on previous Bicron purchases.

1.2.1.5.8.2	Optical Fibers	$6,426.00	$6,426.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	INKIND	6,426	6,426	0 mons	Fri 5/16/03	Tue 11/4/03	$6,426.00	$0.00	$0.00	$6,426.00

Notes

WBS Definition:
Wavelength shifting and clear fibers purchased by INFN and provided in-kind to

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Optical Fibers" continued

Notes

this project for the CCR.

Labor BOE:
n/a

M&S BOE:
See the quote for the CPR fibers, these are the same fibers.
WLS: 10 channels * 1 fiber/channel * 1.5m average * 48 wedges * 10% spares * $2.28/m = $1806
Clear: 10 channels * 1 fiber/channel * 5m average * 48 wedges * 10% spares * $1.75/m = $4620
Total: $6426

1.2.1.5.8.3	Sheet metal and misc. supplies	$2,493.00	$2,493.00	$0.00	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	2,493	2,493	0 mons	Mon 4/14/03	Wed 10/1/03	$2,493.00	$0.00	$0.00	$2,493.00

Notes

WBS Definition:
Sheet metal and other supplies for the shell for the CCR.

Labor BOE:
n/a

M&S BOE:
See the estimate for CPR. This is 20% of the surface area so we use 20% of that estimate of $12464 = $2493.

1.2.1.6	**Preshower Detector Assembly**	**$111,646.00**	**$36,108.00**	**$75,538.00**	**0**	**0**	**0**

Notes

WBS Definition-
Summary task for preshower detector assembly.

1.2.1.6.1	Prepare scintillator tiles	$63,724.00	$0.00	$63,724.00	0	0.3	0

ID	Resource Name	Units	Work	Delay	Start	Finish
2	MechTechF	100%	1,424 hrs	0 mons	Tue 8/12/03	Tue 4/27/04
3	SeniorMechTechF	25%	356 hrs	0 mons	Tue 8/12/03	Tue 4/27/04

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
2	MechTechF	100%	$49,840.00	$0.00	$0.00	$49,840.00
3	SeniorMechTechF	25%	$13,884.00	$0.00	$0.00	$13,884.00

Notes

WBS Definition:
Cutting scintillator tiles to correct size and cutting grooves in them.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Prepare scintillator tiles" continued

Notes

Labor BOE:
This has been done for the prototype, it took 22.5 minutes per tile according to FNAL Lab 8 Director Phyllis Dearing. The final tiles may need slightly more work due to keyed grooves, we'll use an estimate of
1 tile every 30 minutes, 2 per hour, 16 per day.
We need 54*48*10% spare for CPR= 2851. 2851/16 = 178 days of labor.

M&S BOE:
n/a

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.6.2	Prepare optical fibers	$11,814.00	$0.00	$11,814.00	0	0.3	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
2	MechTechF	100%	264 hrs	0 mons	Tue 8/12/03	Fri 9/26/03	$9,240.00	$0.00	$0.00	$9,240.00
3	SeniorMechTechF	25%	66 hrs	0 mons	Tue 8/12/03	Fri 9/26/03	$2,574.00	$0.00	$0.00	$2,574.00

Notes

WBS Definition:
Splicing, polishing and mirroring fibers.

Labor BOE:
Estimate from Ewa Skup. Range for splicing alone was 120-160 fibers per day using CMS procedure. Will assume 100 fibers per day including polishing and mirroring.
We need 54*48*10% spare for CPR= 2851. 2851/100 = 29 days of labor.

M&S BOE:
n/a

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.6.3	Assemble bottom of module	$4,738.00	$4,738.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	4,738	4,738	0 mons	Mon 4/14/03	Fri 3/26/04	$4,738.00	$0.00	$0.00	$4,738.00

Notes

WBS Definition:
Assembly of shell of CPR modules at Argonne.

Labor BOE:
n/a

M&S BOE:
Estimate from Jim Grudzinski (Argonne) based on assembly of prototype modules: 1.5 hr * 48 * 10% spare * $59.82/hr = $4738

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.6.4	Installing fibers into tiles	$15,793.00	$15,793.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	15,793	15,793	0 mons	Wed 10/8/03	Tue 9/21/04	$15,793.00	$0.00	$0.00	$15,793.00

Notes

WBS Definition:
Installing fibers into modules at Argonne.

Labor BOE:
n/a

M&S BOE:
Estimate from Jim Grudzinski (Argonne) based on assembly of prototype modules: 5 hrs/module * 48 modules * 10% spare * $59.82/hr = $15793

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.6.5	Assemble module top	$6,317.00	$6,317.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	6,317	6,317	0 mons	Wed 10/15/03	Wed 9/29/04	$6,317.00	$0.00	$0.00	$6,317.00

Notes

WBS Definition:
Assembly of top of CPR modules at Argonne.

Labor BOE:
n/a

M&S BOE:
Estimate from Jim Grudzinski (Argonne) based on assembly of prototype modules: 2 hr * 48 * 10% spare * $59.82/hr = $6317

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.6.6	Quality control	$9,260.00	$9,260.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	9,260	9,260	0 mons	Wed 11/12/03	Tue 11/23/04	$9,260.00	$0.00	$0.00	$9,260.00

Notes

WBS Definition:
Quality control and supervision by engineer for CPR modules at Argonne.

Labor BOE:
n/a

M&S BOE:
Estimate from Jim Grudzinski (Argonne) based on assembly of prototype modules: 2 hr * 48 * 10% spare * $87.69/hr = $9260

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.7	**Crack Detector Assembly**	**$17,622.00**	**$9,388.00**	**$8,234.00**	**0**	**0**	**0**

Notes
WBS Definition-
Summary task describing the assemble of the CDF Crack Detector.

1.2.1.7.1	Prepare scintillator tiles	$8,234.00	$0.00	$8,234.00	0	0.3	0	

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
2	MechTechF	100%	184 hrs	0 mons	Tue 8/12/03	Fri 9/12/03	$6,440.00	$0.00	$0.00	$6,440.00
3	SeniorMechTechF	25%	46 hrs	0 mons	Tue 8/12/03	Fri 9/12/03	$1,794.00	$0.00	$0.00	$1,794.00

Notes
WBS Definition:
Cutting CCR scintillator tiles to correct size and cutting grooves in them.

Labor BOE:
See the similar estimate for CPR. The sigma cut for the CPR, which takes 30 minutes per tile, is much more complicated than the straight line cut for the CCR. We will estimate 20 minutes per tile for CCR, 3 per hour, 24 per day.
We need 10*48*10% spare for CCR= 528. 528/24 = 22 days of labor.

M&S BOE:
n/a

1.2.1.7.2	Assemble detector with CPR procedure	$9,388.00	$9,388.00	$0.00	0.3	0	0	

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	9,388	9,388	0 mons	Wed 9/10/03	Mon 8/23/04	$9,388.00	$0.00	$0.00	$9,388.00

Notes
WBS Definition:
Assembly of CCR modules at Argonne.

Labor BOE:
Since CCR is 20% of CPR channels we use that total estimate of $46940 * 0.2 = $9388

M&S BOE:
n/a

1.2.1.8	**Fiber Bundle Assembly**	**$29,100.00**	**$29,100.00**	**$0.00**	**0**	**0**	**0**	

Notes
WBS Definition-
Summary task for fiber bundle assembly.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.8.1	Assemble WLS fiber holders	$8,900.00	$8,900.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	8,900	8,900	0 mons	Wed 9/10/03	Thu 3/4/04	$8,900.00	$0.00	$0.00	$8,900.00

Notes

WBS Definition-
Assemble plastic holders for the WLS fibers "pigtails" at MSU.

Labor BOE-
N/A

M&S BOE-
Detailed estimate from MSU engineer Ron Richards. 424 hours at $21.1/hour = $8900

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.8.2	Assemble phototube fixtures	$10,100.00	$10,100.00	$0.00	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	10,100	10,100	0 mons	Thu 10/30/03	Mon 4/26/04	$10,100.00	$0.00	$0.00	$10,100.00

Notes

WBS Definition-
Assemble phototube boxes at MSU.

Labor BOE-
N/A

M&S BOE-
Detailed estimate from MSU engineer Ron Richards. 480 hours at $21.1/hour = $10100

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.8.3	Assemble clear fiber bundles	$10,100.00	$10,100.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	10,100	10,100	0 mons	Wed 11/5/03	Fri 5/7/04	$10,100.00	$0.00	$0.00	$10,100.00

Notes

WBS Definition-
Assemble clear fiber bundles that go from the counters to the phototube box, assembly performed at MSU.

Labor BOE-
N/A

M&S BOE-
Detailed estimate from MSU engineer Ron Richards. 477 hours at $21.1/hour = $10100

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.9	**Physicist or Student Labor**	**$0.00**	**$0.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
Summary task for physicist and student labor testing detectors.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.9.1	Phototube Testing Year 1	$0.00	$0.00	$0.00	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
4	PhysicistU	10%	96 hrs	0 mons	Wed 8/6/03	Fri 1/30/04	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
This cover the testing of phototubes in the first batch.
Labor BOE-
N/A

M&S BOE-

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.9.2	Phototube Testing Year 2	$0.00	$0.00	$0.00	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
4	PhysicistU	10%	96 hrs	0 mons	Mon 12/1/03	Fri 5/21/04	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
This cover the testing of phototubes in the second batch.
Labor BOE-
N/A

M&S BOE-

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.9.3	Phototube Testing Year 3	$0.00	$0.00	$0.00	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
4	PhysicistU	10%	48 hrs	0 mons	Mon 2/14/05	Fri 5/6/05	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
This cover the testing of phototubes in the third batch.
Labor BOE-
N/A

M&S BOE-

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.9.4	Detector Testing	$0.00	$0.00	$0.00	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
4	PhysicistU	10%	208 hrs	0 mons	Wed 11/12/03	Tue 11/23/04	$0.00	$0.00	$0.00	$0.00

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.9.5	Schedule Contingency for Detector Assembly and Testing	$0.00	$0.00	$0.00	0	0	0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Schedule Contingency for Detector Assembly and Testing" continued							
1.2.1.10	**Level 2 Milestones**	**$0.00**	**$0.00**	**$0.00**	**0**	**0**	**0**
	Notes WBS Definition- Summary task for Preshower/Crack Level 3 milestones.						
1.2.1.10.1	First phototube order placed	$0.00	$0.00	$0.00	0	0	2
	Notes WBS Definition- Preshower/Crack milestone. First phototube order placed.						
1.2.1.10.2	1st WLS fiber holder finished	$0.00	$0.00	$0.00	0	0	2
	Notes WBS Definition- Preshower/Crack milestone. first wavelength shifting fiber holder completed						
1.2.1.10.3	First set of phototubes tested	$0.00	$0.00	$0.00	0	0	2
	Notes WBS Definition- Preshower/Crack milestone. First set of production phototubes tested.						
1.2.1.10.4	1st CPR module finished and tested	$0.00	$0.00	$0.00	0	0	2
	Notes WBS Definition- Preshower/Crack milestone. first CPR module completed and fully tested						
1.2.1.10.5	Second set of phototubes tested	$0.00	$0.00	$0.00	0	0	2
	Notes WBS Definition- Preshower/Crack milestone. Second set (of three) production phototubes tested in Japan.						

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.1.10.6	1st CCR module finished and tested	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
Preshower/Crack milestone. first Central Crack detector module completed and fully tested.

1.2.1.10.7	50% CPR Detectors Tested	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
Preshower/Crack milestone. First 1/2 of the production CPR detectors completed and tested.

1.2.1.10.8	50% CCR Detectors Tested	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
Preshower/Crack milestone. first 1/2 of production Central Crack detectors completed and fully tested.

1.2.1.10.9	Final CPR Detector Tested	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
Preshower milestone marking the completion of assembly and testing of the CPR detector.

1.2.1.10.10	Final CCR Detector Tested	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
Crack milestone marking the completion of assembly and testing of the CCR detector.

1.2.1.10.11	Final set of phototubes tested	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
Preshower/Crack milestone marking the completion of production phototube testing in Japan.

1.2.1.10.12	End of Central Preshower Project	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
Preshower/Crack milestone marking the end of the Central Preshower project.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2	**Electromagnetic timing**	**$202,735.00**	**$176,527.00**	**$25,584.00**	**0**	**0**	**0**

Notes

WBS Definition-
Highest level summary for electromagnetic timing project

1.2.2.1	**Research and Development**	**$12,936.00**	**$12,000.00**	**$312.00**	**0**	**0**	**0**

Notes

WBS Definition-
Summary of research and development for electromagnetic timing project

1.2.2.1.1	Procure parts for splitters & cable prototypes, misc test stand equi	$2,000.00	$2,000.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	*USUnivGrants*	*2,000*	*2,000*	*0 mons*	*Mon 6/17/02*	*Mon 7/29/02*	*$2,000.00*	*$0.00*	*$0.00*	*$2,000.00*

Notes

WBS Definition-
Procure parts for splitter and cable prototypes, as well as miscellanious test stand equipment.

Labor BOE-
N/A

M&S BOE-

Notes:

These are the prototypes of the splitter, PEM harness, ASD->TDC cable and miscellanous Test stand equipment. We will use the existing 2nd floor test stands which have ADMEM's and TDC's in working crates.

Splitter: This is 2 harnesses (20 cables) of splitters. The cost per splitter is $25 for a cost of $500. The parts for his have already been purchased, and the splitters built. Written estimate.

PEM harness: This is 1 harness (8 cables). It is the LEMO connectors, the RG174 and the AMP connectors. The LEMO's are $48 total, the cable is $25 total and the AMP connectors are $50 for a total of $123. We are recycling all the parts for this assembly and the parts are all in hand. Written estimate.

We have purchased 2 ASD->TDC cables is purchased directly from 3M at a small-order cost of $700. These parts are all in hand. Written estimate.

Other miscellanous parts include extra LEMO connectors, terminators, BNC->LEMO connectors, short RG174 cables etc. Estimated cost $300.

1.2.2.1.2	Assemble Splitter Prototype	$624.00	$0.00	$0.00	0.5	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	*ElecTechU*	*100%*	*16 hrs*	*0 mons*	*Tue 7/30/02*	*Wed 7/31/02*	*$624.00*	*$0.00*	*$0.00*	*$624.00*

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Assemble Splitter Prototype" continued

Notes

WBS Definition-
This is the assembly of the splitter prototype.

Labor BOE-

Written estimate details the following:

The individual splitters are about 20 minutes and and bundling them up in to a harness takes another 20 minutes. The estimate is rounded to 2 days. This was already done at UC.

To be conservative we assume that this doesn't begin until all the prototype parts are ready.

M&S BOE-
N/A

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.1.3	Assemble PEM harness prototype	$312.00	$0.00	$312.00	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	ElecTechF	5%	8 hrs	0 days	Fri 12/6/02	Wed 1/8/03	$312.00	$0.00	$0.00	$312.00

Notes

WBS Definition-
This is assembling the splitter harness and the PEM harness.

Labor BOE-

The PEM harness is about 1 hour to put the cables into the single AMP connector. We assume a day to be conservative. This will be done by a FNAL tech.

To be conservative we assume that this doesn't begin until all the prototype parts are ready.

M&S BOE-
N/A

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.1.4	Tests to finalize CEM Splitter	$0.00	$0.00	$0.00	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
5	PostDocU	50%	320 hrs	0 days	Thu 8/1/02	Mon 11/25/02	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
The final splitter must be shown to be mechanically compatable with the system, as well as perform as expected without introducing noise or a disruption to the existing CEM system. This is work done by TAMU post-doc. This includes building a test setup.

Labor BOE-
Prototypes of the CEM splitter exist and have been extensively tested with no known problems. A prototype of the mechanical harness exists and is being tested.

M&S BOE-
N/A

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.1.5	Tests to finalize PEM Harness	$0.00	$0.00	$0.00	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
5	PostDocU	10%	72 hrs	0 days	Thu 1/9/03	Thu 5/15/03	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
This is the mechanical testing of a PEM harness between the PEM PMT box and the ASD/TB crates. This includes building a production test setup. This is work done by TAMU post-docs.

Labor BOE-
This estimate is based on previous experience testing harnesses at Fermilab.

M&S BOE-
N/A

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.1.6	Tests to finalize ASD->TDC cables	$0.00	$0.00	$0.00	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
5	PostDocU	10%	72 hrs	0 days	Tue 7/30/02	Thu 12/5/02	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
The current ASD->TDC cable must be shown to pass the mechanical requirements as well as have timing resolution consistent with being small relative to the current TDC resolution (1nsec). These tests will be done by TAMU post-doc.

Labor BOE-
A cable already exists and has undergone detailed preliminary tests. This includes building a tester for the cables. Based on discussions with Fermilab electrical engineers.

M&S BOE-
N/A

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.1.7	Build ASD/TB Prototypes and test	$10,000.00	$10,000.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	INKIND	10,000	10,000	0 mons	Mon 6/17/02	Tue 10/15/02	$10,000.00	$0.00	$0.00	$10,000.00

Notes

WBS Definition-
The Italian group will make a new batch of ASD's which are functionally identical to the existing ASD's but with a new output connector such that there is only one cable out.

Labor BOE-
N/A

M&S BOE-
Written estimate based on previous experience building equivalent boards.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.1.8	Prototype ASD tests with CEM Splitter, TDC cable, and TDC	$0.00	$0.00	$0.00	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
5	PostDocU	50%	120 hrs	0 days	Thu 1/9/03	Thu 2/20/03	$0.00	$0.00	$0.00	$0.00

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Prototype ASD tests with CEM Splitter, TDC cable, and TDC" continued

Notes

WBS Definition-
Once we have an ASD prototype we can test it on a test bench with the splitters, the PEM harnesses as well as the finalized ASD->TDC cable and a TDC. While the final tests cannot be done until we have a prototype ASD, we can do much of the setup work before that. This is work done by TAMU post-doc.

Labor BOE-
These numbers are based on previous experience doing integration testing with ASDs and assume that all the parts individually have been shown to work.

M&S BOE-
N/A

1.2.2.1.9 Assembly of wedge test stand — $0.00 | $0.00 | $0.00 | 0 | 0.5 | 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
5	PostDocU	20%	144 hrs	0 days	Tue 7/30/02	Thu 12/5/02	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
This is setting up the test stand with all the components as they come available. This will be done at B0 by TAMU post-docs.

Labor BOE-
This is based on previous experience setting up the existing components of the test stand.

M&S BOE-
N/A

1.2.2.1.10 Wedge test using all components — $0.00 | $0.00 | $0.00 | 0 | 0 | 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
5	PostDocU	50%	188 hrs	0 days	Fri 2/21/03	Mon 4/28/03	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
Once we have all the components we do a wedge test with all the pieces together. While the final tests cannot be done until we have a prototype ASD, we can do much of the setup work before that. This is work done by TAMU post-doc.

Labor BOE-
This is based on previous integration testing at test stands.

M&S BOE-
N/A

1.2.2.2 Purchase parts for components and Produce — $189,799.00 | $164,527.00 | $25,272.00 | 0 | 0 | 0

Notes

WBS Definition-
This is high level summary for purchasing parts for the components and doing production. We note that the components for this project are:

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Purchase parts for components and Produce" continued

Notes

CEM Splitter harnesses, PEM cable harnesses, TB, ASD's, ASD->TDC cables and TDC's. We itemize each part here.

Parts = 227,128 Labor = 15,552 Parts & Labor = 242,680 Recycling = 83,840

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.2.1	**CEM Splitter**	**$43,846.00**	**$27,934.00**	**$15,912.00**	**0**	**0**	**0**

Notes

WBS Definition-
This is the summary task for the CEM Splitter. The CEM splitter is used to pull off a small copy of the CEM anode signal for use into a ASD/TB. It is a completely passive device.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.2.1.1	Procure Splitter parts	$27,934.00	$27,934.00	$0.00	0.3	0	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
9	*USUnivGrants*	*27,934*	*27,934*	*0 mons*	*Fri 12/6/02*	*Thu 1/23/03*	*$27,934.00*	*$0.00*	*$0.00*	*$27,934.00*

Notes

WBS Definition-
Procure the CEM splitter parts

Labor BOE-
N/A

M&S BOE-
EMTiming Splitter parts list: (Estimate based on completion of 10 prototype splitters, written estimates for all)

960+96 spares- Lemo right angle receptacle EPL.00.250 NTN. $6.10/part. These parts are in hand.

960+96 long Rg174 cables with lemo connectors on one end. Average of 26 ft/cable=25,344 ft.
The connector we use is LEMO FFS.00.25.CTCE31 (equivalent to the Kings K-LOC 1075-1). Part $6.36/part.
All the cable is in hand and is being recycled ($0.14/foot). The connectors are in stock and ordered.

960+96 short Rg174 cables with lemo connectors on one end (LEMO-ettes).
These are all in hand and are recycled. Value: $6/connectors, $0.10 cable, $2.75 to connect => $9/LEMO-ette.

1200- Phillips TX/13/7.1/4.8-3E27 ferrite toroids @ $0.208ea
In hand.

2400 cable clamps (cable-ties) Panduit PLT.6SM-M 1000/pkg approx $40, and
40 PKgs---Heat shrink tubing SPC FPS-048-6012-CLR 3/4in X 6in long
1 pkg can do 36 boards. Total cost $450. These are in hand.

30 Printed circuit boards [40 channels/ board after cutting on scored perforations] which are part UC dwg A-2508. Price

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Procure Splitter parts" continued

Notes

$1K. These are in hand.

Even though the parts are in stock, we assume a 6 week lead-time to be conservative.

Parts = 27,934 Labor = 9,792 Parts&Labor= 37,726 Recycling= 13,052

1.2.2.2.1.2	Build Splitters	$15,912.00	$0.00	$15,912.00	0	0.5	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
1	*ElecTechF*	*100%*	*408 hrs*	*0 days*	*Fri 1/24/03*	*Fri 4/4/03*	*$15,912.00*	*$0.00*	*$0.00*	*$15,912.00*

Notes

WBS Definition-
This is the construction of the splitters While production can begin well before we have all the parts, for conservativeness we assume that it cannot until after all the parts are assembled.

Labor BOE-
Written estimate. Prototyping has shown assembly to be 20 minutes/splitter for an experienced technician (ElecTechF).
960+96 splitters needed => 44 technican days. 1 day of overall setup. 2 days of setup fixing/techician. 3 Technicans working in parallel for a total of 51 days.

M&S BOE-
N/A

1.2.2.2.1.3	Test CEM Splitter Cables	$0.00	$0.00	$0.00	0	0.5	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
6	*StudentU*	*100%*	*40 hrs*	*0 days*	*Mon 4/7/03*	*Fri 4/11/03*	*$0.00*	*$0.00*	*$0.00*	*$0.00*

Notes

WBS Definition-
Testing of CEM Splitter cables.

Labor BOE-
Written estimate shows has each splitter tested individually. Use the test setup from above. Should take about 20 minutes per harness (20 cables). This is about 4 days of testing and will go in parallel with the production. This work will be done by TAMU. To be conservative, we assume 5 days of a 1/2 time student after the end of production.

M&S BOE-
N/A

1.2.2.2.2	**PEM Cable Harness**	**$23,887.00**	**$14,527.00**	**$9,360.00**	**0**	**0**	**0**

Notes

WBS Definition-
Summary task of creating the PEM Cable Harnesses

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"PEM Cable Harness" continued

Notes

1.2.2.2.2.1	Procure PEM Harness Parts	$14,527.00	$14,527.00	$0.00	0.3	0	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
9	*USUnivGrants*	*14,527*	*14,527*	*0 mons*	*Fri 5/16/03*	*Mon 7/14/03*	*$14,527.00*	*$0.00*	*$0.00*	*$14,527.00*

Notes

WBS Definition-
Procure the parts for the PEM Harnesses

Labor BOE-
N/A

M&S BOE-
Written estimates exist for all.
The PEM harness is the set of 16 RG174 cables which go from the PEM dynode directly to the
ASD Transition boards. There are 4 lines terminated in 50 ohms. There are 48 harnesses (24 wedges per side, East and West). The harness connects to the Plug light box using two AMP connector packages (parts list below), which are connected to the 16 RG174 cables which are terminated with male LEMO's on the end ASD/TB end.

Part's list and costs:
768+76 spares Male LEMO connectors: (FFS.00.250.CTCE, $6.36). We assume a 6 week lead time. Total cost $6.36*844=$5,367.84

The cable from the PMT connectors to the ASD/TB is 19,440 ft (768+76 spares *23 ft) of RG174 which is $0.14/foot; The total value is $2,720. We are recycling all of it and the cable is already in hand.

The AMP connector packages bundle the RG174 cables so they can be connected to the plug light boxes. We note that the 400 50-ohm terminators are not explicitly costed as the parts should be under $1 and the labor to install them is part of the overall assembly. The parts for a single harness are:

AMP 1-332056-0 Ferrule 1000*$0.20 (Need 768+78 spares. Come in packages of 1000)
AMP 51565-1 Socket 1100*$2.53 (Need 960+96 spares. Come in packages of 100)
AMP 201356-1 Connector 106*$4.02 (Need 96+10 spares. We are recycling 50 that we have in hand)
AMP 204087-1 Housing 106*$23.98 (Need 96+10 spares. Come in packages of 100. We are recycling 6 of the 36 that we have in hand.)
AMP 200867-1 Female Jackscrew Kit 106*$1.72 (Need 96+10 spares. Come in packages of 100. We are recycling 6 of the 14 that we have in hand.)
AMP 200868-1 Male Jackscrew Kit 106*$2.20 (Need 96+10 spares. Come in packages of 100. We are recycling 6 of the 14 that we have in hand.)

Parts = 14,527 Labor = 5,760 Parts & Labor = 20,287 Recycling = 3,188

The longest lead time is 40 days which is on the 51565-1.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.2.2.2	Build PEM Harnesses	$9,360.00	$0.00	$9,360.00	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	ElecTechF	100%	240 hrs	0 days	Tue 7/15/03	Mon 8/25/03	$9,360.00	$0.00	$0.00	$9,360.00

Notes

WBS Definition-
This is the production building of the PEM harnesses. This is the production of the PEM harnesses. This requires the parts to be in. However, much of the production can go in parallel since it is components. We assume all parts have arrived before starting production. We also assume that the CEM splitter production is complete.

Labor BOE-
Written estimate.
The PEM harness is the set of 16 RG174 cables which go from the PEM dynode directly to the
ASD Transition boards. There are 4 lines terminated in 50 ohms. There are 48 harnesses (24 wedges per side, East and West). The harness connects to the Plug light box using two AMP connector packages (parts list below), which are connected to the 16 RG174 cables which are terminated with male LEMO's on the end ASD/TB end.

Based on previous construction of similar harnesses we estimate this is 4 hrs/harness and 48 harnesses -> 24 days. We assume an additional 2 days/tecnician to setup and fix. With 3 ElecTechF this can take 10 days. The FNAL rate for

M&S BOE-
N/A

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.2.2.3	Test PEM Harnesses	$0.00	$0.00	$0.00	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
6	StudentU	100%	40 hrs	0 days	Tue 8/26/03	Tue 9/2/03	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
Testing the production versions of the PEM harnesses.

Labor BOE-

Each harness needs to be tested. Use the test setup from above. Based on previous testing of cables with a test setup, this should take about 20 minutes per harness (16 cables + 4 terminators) for 48 harnesses. This is about 4 days of testing and will go in parallel with the production. This work will be done by TAMU. To be conservative, we assume 5 days of 1/2 time student, and for scheduling purposes assume no work will start until after the end of production.

M&S BOE-
N/A

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.2.3	**ASD and Transition Boards**	**$89,550.00**	**$89,550.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
This is the summary task for building and testing the ASD and Transition boards.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.2.3.1	Produce ASD and Transition boards	$89,550.00	$89,550.00	$0.00	0.3	0	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
10	*INKIND*	*89,550*	*89,550*	*0 mons*	*Fri 2/21/03*	*Thu 12/4/03*	*$89,550.00*	*$0.00*	*$0.00*	*$89,550.00*

Notes

WBS Definition-
Produce the ASD and Transition boards.

Labor BOE-

From written estimate: The time to produce, including lead times for parts, labor and testing, for both the transition board and the ASD is 10 months.

M&S BOE-

ASD and Transition Board costs (copy of written estimate)

These boards are virtually identical to those which are already in use in the CDF Run II detector. They were built by the Frascati group and the estimates below are based on that experience.

Transition board costs:

(1) Printed circuit board 130 $

(2) Front panel + VME conn. 50 $ (**)
(1 front panel + 2 VME connectors)

(3) LEMO conn. on the board 275 $ ($5.73 $/each x 48 input)

(4) Transformers 36 $

TOTAL 490 $

ASD Costs:

(1) Components 500$

(2) Printed circuits 350-400$ (*)

(3) Assembly of (1)+(2) 350-400$ (*)

(4) Connectors + front panels 50-150 (**)

(5) Assembly of (4) 50$

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Produce ASD and Transition boards" continued

Notes

1300-1500

Notes:
(*) this depends "on" the produced quantity.
(**) Estimate. Last time materials came from FNAL

Total cost = 45*(1500+490) = $89,590

1.2.2.2.3.2	Test ASDs and Transition boards	$0.00	$0.00	$0.00	0	0.5	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
5	*PostDocU*	*100%*	*160 hrs*	*0 days*	*Fri 12/5/03*	*Wed 1/7/04*	*$0.00*	*$0.00*	*$0.00*	*$0.00*

Notes

WBS Definition-
This the final checkout of the boards at FNAL by TAMU people using the test stand. We assume here that each ASD and Transition Board has been thoroughly tested at INFN as well.

Labor BOE-
Based on estimates to fix broken ASD/TB pairs we estimate 3 ASD/TB board pairs/day => 2 weeks for the CEM, 2 week for the PEM => 4 weeks.

M&S BOE-
N/A

1.2.2.2.4	**ASD->TDC Cables**	**$22,516.00**	**$22,516.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
This is the summary task for the ASD->TDC Cables which go up stairs.

1.2.2.2.4.1	Purchase ASD to TDC cables	$22,516.00	$22,516.00	$0.00	0.5	0	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
10	*INKIND*	*22,516*	*22,516*	*0 mons*	*Fri 1/17/03*	*Fri 3/28/03*	*$22,516.00*	*$0.00*	*$0.00*	*$22,516.00*

Notes

WBS Definition-
Purchase the ASD to TDC cables.

Labor BOE-
N/A

M&S BOE-
Written estimate. These are the ASD->TDC Cables which go upstairs. This is the 220 foot 3M 3756/68 and 3M 10168-8100-EE cable and connector assembly. There are 24 (+8 spares) for the

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Purchase ASD to TDC cables" continued

Notes

CEM and 16 (+4 spares) for the PEM. These are $433/cable for a total of $13,586 for the CEM, and $8,660 for the PEM for a total of $22,516. We assume 10 week lead time on these cables.

1.2.2.2.4.2	Test ASD->TDC Cables	$0.00	$0.00	$0.00	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
6	StudentU	10%	4 hrs	0 days	Mon 3/31/03	Fri 4/4/03	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
This is the testing of the ASD->TDC cables.

Labor BOE-
N/A

M&S BOE-
Based on previous experience testing these cables from electrical engineers (Steve Chappa), we estimate it will take a full week of a TAMU students time to test 40.

1.2.2.2.5	**VME Crate for TDCs**	**$10,000.00**	**$10,000.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
This is the summary task for putting together the VME crate for the TDC's. This is the crate on the first floor which will contain all the TDC's for both the CEM and the PEM. As noted elsewhere, this crate will contain a Tracer, power supplies, and processor. There are 6 TDCs for the CEM and 4 TDCs for the PEM.

1.2.2.2.5.1	Procure VME Crate for TDCs	$0.00	$0.00	$0.00	0.1	0	0

Notes

WBS Definition-
Procure VME crate for TDC's

Labor BOE-
N/A

M&S BOE-
This is the crate for the upstairs TDC crate. This is being recycled and has a value of $5,000. This estimate is based on the Run IIa procurment as related by Peter Wilson (CDF Run 2a Level 2 Electronics Project manager).

1.2.2.2.5.2	Procure VME Crate Power Supply	$2,500.00	$2,500.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	USUnivGrants	2,500	2,500	0 mons	Fri 5/16/03	Mon 7/28/03	$2,500.00	$0.00	$0.00	$2,500.00

Notes

WBS Definition-
Procure the VME crate power supply.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level

"Procure VME Crate Power Supply" continued

Notes

Labor BOE-
N/A

M&S BOE-
This is the power supply for the upstairs TDC readout crate. The cost is $2,500 and we assume a 10-week lead time. Written estimate.

1.2.2.2.5.3	Procure VME Crate Processor	$2,500.00	$2,500.00	$0.00	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	USUnivGrants	2,500	2,500	0 mons	Fri 5/16/03	Fri 6/13/03	$2,500.00	$0.00	$0.00	$2,500.00

Notes

WBS Definition-
Procure VME crate processor for the upstairs TDC readout crate.

Labor BOE-
N/A

M&S BOE-
Written estimate from Peter Wilson(CDF Run 2a Level 2 Electronics Project manager) has a cost of $2500 and an typical a 10 week lead-time.

1.2.2.2.5.4	Procure Tracer	$5,000.00	$5,000.00	$0.00	0.1	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	USUnivGrants	5,000	5,000	0 mons	Fri 5/16/03	Fri 6/13/03	$5,000.00	$0.00	$0.00	$5,000.00

Notes

WBS Definition-
This is the Tracer for the upstairs TDC readout crate.

Labor BOE-
N/A

M&S BOE-
An estimate from Peter Wilson (CDF Run 2a Level 2 Electronics Project manager) based on the Run 2A purchasing has this board being recycled and a value of $5,000.

1.2.2.2.5.5	Test crate, PS, processor and Tracer	$0.00	$0.00	$0.00	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
5	PostDocU	100%	400 hrs	0 days	Tue 7/29/03	Tue 10/7/03	$0.00	$0.00	$0.00	$0.00

Notes

WBS Definition-
Test the crate, power supplies, process and the tracer which are the individual components of the upstairs TDC crate.

Labor BOE-
This will be done by a TAMU post-doc and estimates are based on discussion with Peter Wilson (CDF Run 2a Level 2 Electronics Project manager).

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Test crate, PS, processor and Tracer" continued							

Notes

M&S BOE-
N/A

1.2.2.2.6	**TDC Boards**	**$0.00**	**$0.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
This is the summary task for the procuring of the TDC boards.

1.2.2.2.6.1	Recycle TDC Boards	$0.00	$0.00	$0.00	0	0	0

Notes

WBS Definition-
This is where we denote getting the TDC boards by recycling the small-via LVDS TDC's.

Labor BOE-
N/A

M&S BOE-
They represent no additional cost to the project and only add value as they would otherwise be unused. A written estimate shows that these TDC's originally cost $4,800/board. We are using a total of 6+1 spare in the central and 4+1 spare for the PEM for a total of 12 in the system. The CEM value is $33,600 and a PEM total of $24k, for a system total of $57,600. The current best estimate of the arrival date of the boards is mid-March 2003.

1.2.2.2.6.2	Test TDC Boards	$0.00	$0.00	$0.00	0	0.5	0

ID	*Resource Name*	*Units*	*Work*	*Delay*	*Start*	*Finish*	*Cost*	*Baseline Cost*	*Act. Cost*	*Rem. Cost*
5	*PostDocU*	*50%*	*120 hrs*	*0 days*	*Wed 11/19/03*	*Wed 1/7/04*	*$0.00*	*$0.00*	*$0.00*	*$0.00*

Notes

WBS Definition-
Test TDC boards

Labor BOE-
This is the testing of the TDC boards for use in the EMTiming system. We assume here that this takes 6 weeks and includes fixing broken boards. This is based on previous experience fixing these boards.

M&S BOE-
N/A

1.2.2.2.7	**EMTiming Level 2 Milestones**	**$0.00**	**$0.00**	**$0.00**	**0**	**0**	**0**

Notes

WBS Definition-
This is the procurement milestone summary task

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.2.7.1	Prototype Testing Complete	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
This milestone is when we have tested all the components together for both the CEM and PEM.

1.2.2.2.7.2	CEM Splitters ready for installation	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
This milestone indicates when all the spliiters are completed.

1.2.2.2.7.3	PEM Harnesses ready for installation	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
This milestone indicates when all the PEM harnesses are completed.

1.2.2.2.7.4	ASD->TDC Cables ready for installation	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
This milestone indicates when all the ASD-> cables are ready for installation.

1.2.2.2.7.5	All cables done and ready for installation	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
This milestone indicates when all the cables are completed.

1.2.2.2.7.6	ASD/TB ready for installation	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
This is when all the ASD's and TB are done and ready for installation.

1.2.2.2.7.7	Downstairs components ready for installation	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
When all the cables are made and the ASD/TB boards are done, we are ready to install in the hall.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.2.2.7.8	VME Crate ready for installation	$0.00	$0.00	$0.00	0	0	2
	Notes WBS Definition- This milestone indicates when all the VME crate is ready for installation.						
1.2.2.2.7.9	TDC boards ready for installation	$0.00	$0.00	$0.00	0	0	2
	Notes WBS Definition- This milestone indicates when all the TDC boards are ready for installation.						
1.2.2.2.7.10	Upstairs components ready for installation	$0.00	$0.00	$0.00	0	0	2
	Notes WBS Definition- When the TDC's and TDC crates are done, we are ready for the upstairs installation.						
1.2.2.2.7.11	All EMTiming components ready for installation	$0.00	$0.00	$0.00	0	0	2
	Notes WBS Definition- When all EMTiming components are ready for installation.						
1.2.3	**Calorimeter Milestones**	**$0.00**	**$0.00**	**$0.00**	**0**	**0**	**0**
	Notes WBS Definition- These are the EMTiming management milestones						
1.2.3.1	PAC Review	$0.00	$0.00	$0.00	0	0	4
	Notes WBS Definition- This is the preliminary review approval process before Stage 1 approval and before critical decision 1.						
1.2.3.2	Aproval to spend Construction funds	$0.00	$0.00	$0.00	0	0	3
	Notes WBS Definition- This is the DOE critical decision. It is used, among other things, to finalize the final Italian funding.						

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.2.3.3	Italian R&D Funding Approval	$0.00	$0.00	$0.00	0	0	4

Notes
WBS Definition-
This is the preliminary approval needed for funding of the ASD prototypes to be built by the INFN groups

1.2.3.4	Full Italian Government Approval	$0.00	$0.00	$0.00	0	0	3

Notes
WBS Definition-
Project has to be approved by Italian Government due the Italian government funds used on the project.

1.2.3.5	End of Calorimetry Project: Level 2	$0.00	$0.00	$0.00	0	0	2

Notes
WBS Definition-
This is the end of the calorimetery project and is the Level 2 milestone. This milestone is coupled to the corresponding level 3 milestone with added schedule contingency.

1.2.3.6	End of Calorimetry Project: Level 1	$0.00	$0.00	$0.00	0	0	1

Notes
WBS Definition-
This is the end of the calorimetery project and is the Level 1 milestone. This milestone is coupled to the corresponding level 2 milestone with added schedule contingency.